Kahekili Herbivore Fishery Management Area: 2025 Results Brief

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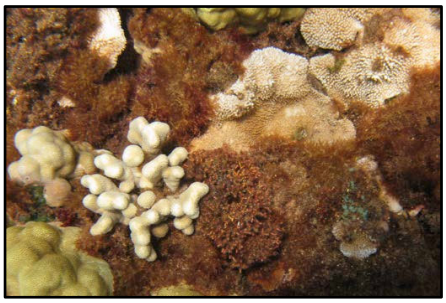
Summary

In response to concerns about declining condition of local coral reefs, the state of Hawai'i created the Kahekili Herbivore Fishery Management Area (KHFMA) along an approximate 2-mile stretch of coastline in Ka'anapali, West Maui. The KHFMA went into effect in July 2009, and prohibits harvest of coral reef herbivores: surgeonfishes, parrotfishes, chubs, and sea urchins. This management effort is designed to restore natural grazing processes within the area, and by doing so help to prevent excessive seaweed growth that would otherwise compete with corals. Resource users can benefit from improved reef condition, including fishers who can continue to fish for non-herbivorous species within the KHFMA.



When herbivores are abundant *and nutrient levels are not excessive, dominant algae are often cropped turf (bare/green) and CCA (pink).*

When there are few herbivores*, dense or upright seaweed develops, including thick turf and macroalgae that can overgrow, stress, or kill coral.*



The Importance of Herbivores

Corals, algae (seaweed), and other benthic organisms compete for space on the reef. Corals thrive when reef algae are dominated by cropped forms: sparse turf and crustose coralline algae (CCA). In particular, CCA can help new corals become established on the reef. Just as sheep in a field prevent large plants from taking over, coral-reef herbivores help to prevent excessive algal growth. Maintaining healthy herbivore populations and controlling other factors that damage corals are ways to increase corals' ability to resist and recover from other stressors like ocean warming events that can cause coral bleaching and mortality.

A Timeline of Events: Trends in the KHFMA

2008–2015 Following the establishment of the KHFMA in 2009, both parrotfish and surgeonfish biomass steadily increased until appearing to level off by 2015 (Figure 1). In particular, there were noticeable increases in large parrotfish during this time (Figure 2). Corresponding with these increases were steady reductions in the cover of problem seaweeds (macroalgae and dense turf) and about a 4-fold increase in CCA (Figure 3). Coral cover, which had been declining

at the time of the KHFMA establishment, leveled off and perhaps began increasing in 2013 and 2014.

2014–2018 In 2015, Hawai‘i experienced a prolonged period of high temperatures that led to mass coral bleaching and substantial coral death across much of the state. This major bleaching event followed a moderate bleaching event that took place only a year prior in 2014. Maui suffered ~20% loss in coral with the impacts varying around the island. In the KHFMA, parrotfish biomass increased following the 2015 event, reaching more than four times (+331%) the baseline value in 2018 (Figure 1); the greatest increases were among the larger sizes (Figure 2). This “surge” in parrotfish was not mirrored by surgeonfish (Figure 1); biomass in 2018 was about double (+71%) the initial value in 2008. Macroalgae decreased from 2.4% in 2014 to 1.28% in 2018 (Figure 3). Only a small decline in coral cover was evident by 2018 (34.9% in 2014, 30.6% in 2018), and CCA cover appeared to undergo minimal change (12.8% in 2014, 12.4% in 2018).

2018–2021 In 2019, Hawai‘i experienced another moderate bleaching event, followed by the outbreak of the global COVID pandemic in 2020. The highly-elevated parrotfish biomass in 2018 was not sustained through 2021, with biomass returning to levels similar to those leading up to and during 2015 (Figures Figure **1** and Figure **2**). Surgeonfish biomass was reduced in 2021, with levels similar to those closer to when the KHFMA was established (Figure 1). Macroalgal cover in 2021 was the lowest ever observed in the KHFMA (0.19%), yet cover of coral (23.6%) and CCA (7.5%) had also declined (Figure 3).

2024–2025 Both parrotfish and surgeonfish biomass increased in 2024 and 2025 from 2021 levels. By 2024, parrotfish biomass was between levels seen in 2016 and 2018 (Figure 1). In 2025, parrotfish biomass peaked to almost 500% more than when the KHFMA was established in 2009. Surgeonfish biomass peaked in 2024 and remained steady throughout 2025. Coral cover continued to decline through 2024, although not as rapidly as from 2018 to 2021 (Figure 3). There was a small increase in coral cover in 2025. Macroalgae increased slightly through 2024 and 2025, to levels similar to 2018, although it is low overall, and CCA has continued to decline (7.2% in 2021 to 5.0% in 2025).

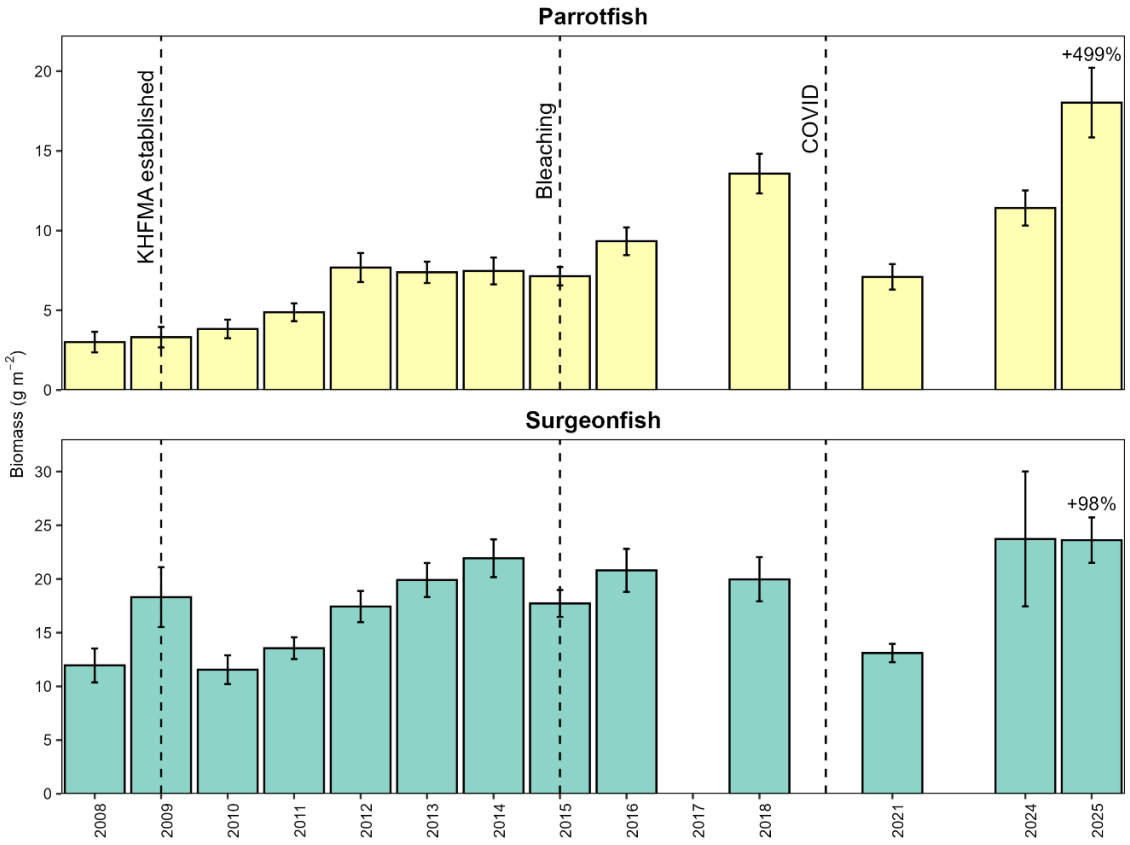


Figure 1. Trends in herbivorous fishes from 2008-2025. Dashed lines indicate the timing of key events like major bleaching and the COVID pandemic.

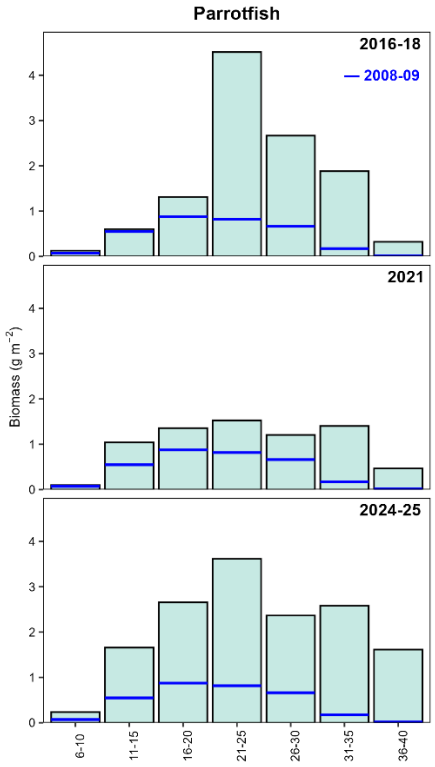


Figure 2. Parrotfish biomass per size class (cm TL). Blue lines are initial baseline levels of biomass in 2008-2009.

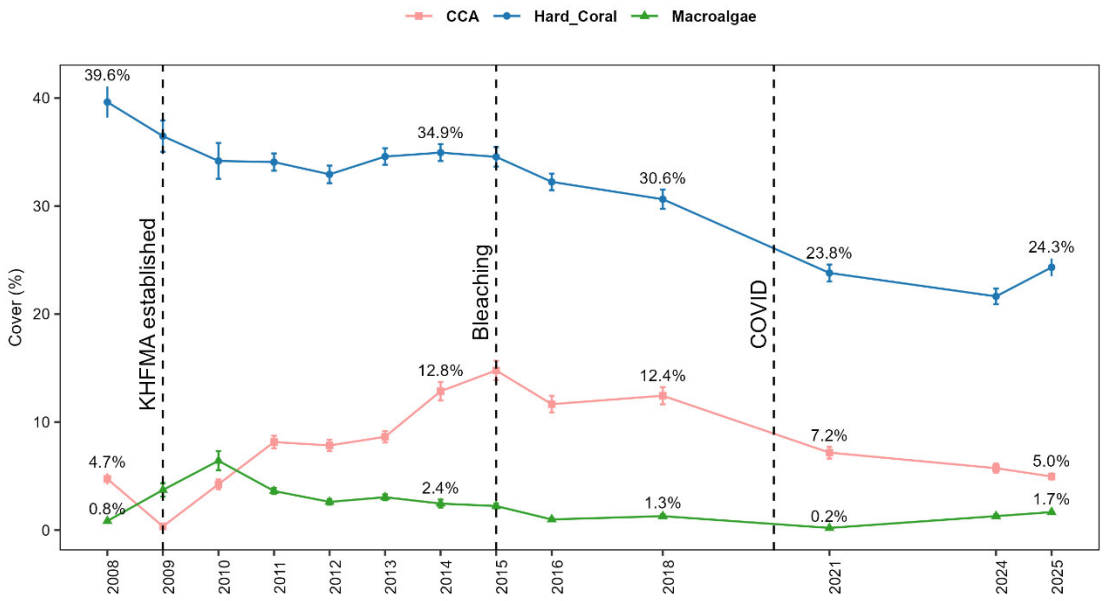


Figure 3. Reef composition in the KHFMA. Trends in key groupings of the benthos.

What Do These Trends Mean?

Although biomass of parrotfish and surgeonfish declined from 2018 to 2021, both families showed an increase in biomass in 2024–2025. All size classes of parrotfish increased from 2021 (Figure 2).

On protected reefs with few predators, parrotfish population sizes are largely driven by food availability. Because the gradual declines in coral cover within the KHFMA created more grazeable surfaces, we would normally expect to see herbivore biomass increase in response. However, parrotfish biomass unexpectedly dropped in 2021. Rather than environmental factors, this decline may reflect non-compliance and a temporary increase in harvesting pressure during the COVID-19 pandemic. Encouragingly, data from 2024 and 2025 surveys highlight the potential for the KHMFA parrotfish population to rapidly rebound (Figure 4). This was particularly evident in the spur-and-groove habitat, which saw the greatest losses in 2021 but the most dramatic gains over the last two years. In contrast, the deeper reefs have remained relatively stable since 2018 with only a slight upward trend, while the Beach Park showed a strong recent recovery to levels seen in 2014 and 2016. Whether parrotfish biomass continues to increase across these habitats or begins to level off will be an important indicator of the maximum population sizes that these reefs can sustain.

Similar to parrotfish, surgeonfish biomass also showed a strong rebound in both spur-and-grove and deep reef habitats in 2024, and a recovery in the Beach Park in 2025. Unlike parrotfish however, surgeonfish biomass remained relatively stable in both the deep reef and spur-and-grove areas in 2025 (Figure 4). These levels are similar to the highest values recorded in the nearly 20-years of monitoring in Kahekili and may be indicative of the areas carrying capacity. As with parrotfish, fundamental differences in the habitat types may partly explain the differences in biomass, but the drop in 2021 and increase in 2024-2025 could reflect varying levels of compliance, especially during the COVID pandemic.

Overall, it appears herbivore biomass in the KHFMA has remained sufficient for maintaining macroalgal cover at low levels. Reef composition through 2018 may have suggested minimal to low impacts from bleaching events, yet with recent declines in coral and CCA cover through 2024, the long-term extent to which the KHFMA can effectively maintain reef condition and prevent coral loss in the face of multiple bleaching events is unclear. Continued monitoring and comparisons of the trajectory of reefs in the KHFMA versus other reefs around Maui will provide the context needed to assess the utility of the KHFMA.

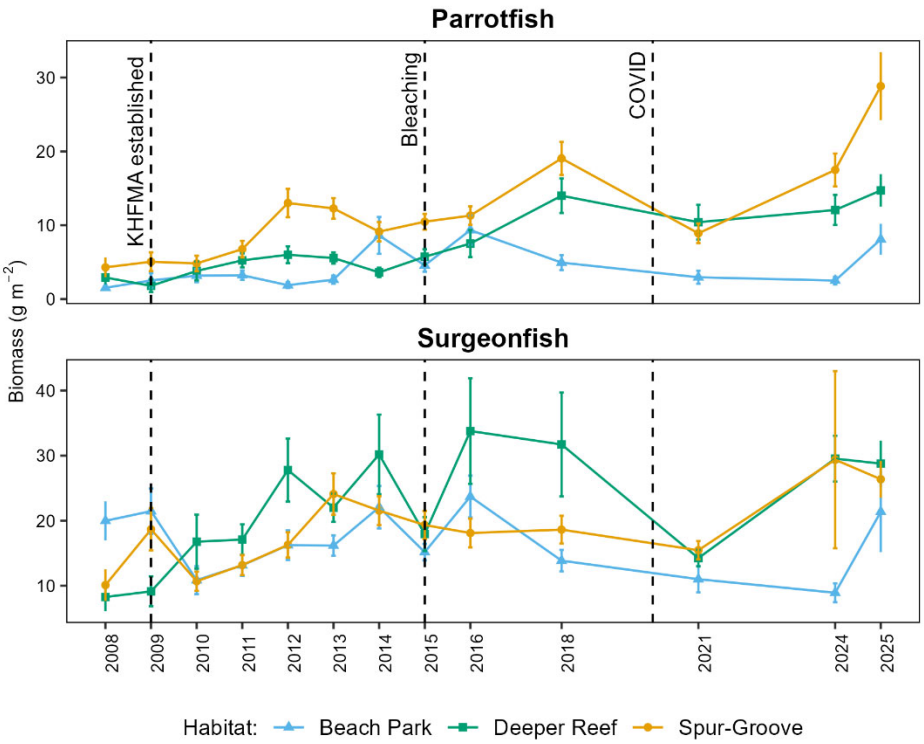


Figure 4. Trends in parrotfish biomass by KHFMA reef area.